ILLUMINATION AND DISPLAY DEVICE

Background Information

The present invention relates to an illumination device for a display instrument according to the definition of the species of the main claim. Illumination devices for display instruments with two different scale markings are known in which both the scale markings as well as a pointer scale are illuminated by one light source. If individual segments of the pointer scale are to be darkened, a known method is for this darkening to be implemented using a switchable liquid crystal cell. The liquid crystal cell is, however, expensive to manufacture and difficult to mount, especially since it is generally made of glass. A further known method is to arrange additional light sources to illuminate each pointer scale.

Advantages of the Invention

In contrast, the illumination device according to the present invention having the features of the main claim has the advantage that a first scale marking can be illuminated by a first light source and a second scale marking can be illuminated by an optical waveguide using light guidance separately from the pointer scale. The light path from the first light source to the scale markings is separated from an illumination of the pointer scale by light funnels, making undisturbed illumination of the pointer scale or of parts of the pointer scale possible, so that parts of the pointer scale can also be switched or illuminated with a different color than that of the scale marking. Therefore, a second light source for the second scale marking can be eliminated.

The measures detailed in the subclaims make advantageous refinements and improvements of the illumination device specified in the main claim possible. It is of particular advantage to arrange the light sources as well as the light funnel on a circuit board since this makes it possible to supply the light sources with an operating voltage in a simple manner without additional wire connections.

Moreover, it is advantageous to illuminate the pointer scale by a plurality of light sources so that individual segments of the pointer scale can be illuminated separately. For this purpose, the individual light sources can preferably be electrically activated separately.

Furthermore, it is advantageous to produce the light funnel from a reflective material to ensure that illumination of the pointer scale is as homogeneous and efficient as possible. In this regard, it is of particular advantage to integrate the individual light funnels in one component, which is preferably produced by injection molding of a plastic material. This component is easy to mount and can be used to affix the optical waveguide at the same time.

Furthermore, it is advantageous to use the illumination device in a display instrument and for better homogenization to arrange a diffusing screen between the illumination device and a dial face in order to attain a brightness distribution that is as homogeneous as possible, in particular of the light from the first light source.

Furthermore, it is advantageous to implement a cruise control display in a vehicle with the illumination device according to the present invention or the display device according to the present invention in which, in addition to an instantaneous vehicle speed displayed by a pointer, a target speed specified by a driver is shown in a display by partial illumination of the pointer scale or by a color change of the pointer scale. As a result, the user obtains information concerning the instantaneous vehicle speed as well as a set target speed in one glance at the display instrument.

Drawing

Figure 1 shows an instrument cluster with a display instrument according to the present invention; Figure 2 shows a first top view of an illumination device designed according to the invention in a display instrument; Figure 3 shows the illumination device according to the present invention of Figure 2 in a section along line III; Figure 4 shows the illumination device according to the present invention according to Figure 2 in a longitudinal section according to line IV.

Description of the Exemplary Embodiment

The illumination device according to the present invention can be used in various display instruments having at least one pointer scale and two markings of such a pointer scale, e.g., with various physical units or with various directly determinable variables, e.g. for general use in measuring instruments. The present invention is explained on the basis of its use for a display instrument in a motor vehicle. Figure 1 shows an instrument cluster 1 having a plurality of displays which is arranged in front of a driver in a motor vehicle and which informs the driver concerning important vehicle parameters. Arranged to the right and left sides of instrument cluster 1 are warning fields 2 that can be illuminated individually and serve to warn a driver of, e.g., a defect in the vehicle. Moreover, a temperature display 3 and a time display 4 are arranged in instrument cluster 1 on which the exterior temperature and the time are shown by a liquid crystal display. Displays for a turn signal indicator 6 are provided on a dial face 5 and are preferably illuminated via light-emitting diodes. In addition, a coolant temperature gauge 7, a fuel gauge 8 and a tachometer 9 are arranged on dial face 5, pointers 7′, 8′, and 9′, respectively, serving to indicate the particular measured variable in front of a pointer scale. An odometer 10 is arranged in the center of dial face 5, additional warning fields 2′ being arranged adjacent to the odometer. Odometer 10 is surrounded by a speedometer 11 in the shape of a semicircle, the instantaneous speed of the vehicle being shown by a position of a pointer 12 over a pointer scale 20. Pointer scale 20 has a first scale marking 21 with values from "0" to "160" in intervals of 20 each, which are characterized by a units designation 22 as "mph" miles per hour. In addition, speedometer 11 has a second scale marking 23 with an auxiliary scale 24. In second scale marking 23, the values range from "20" to "260" in increments of twenty and are characterized by a second units designation 25 as "km/h" kilometers per hour. Pointer scale 20 is used to display a target speed. Pointer scale 20 is made up of individual segments 26, each of which can be illuminated individually. An illumination device according to the present invention extends behind speedometer 11 so that first scale marking 21 and second scale marking 23 can be illuminated together with auxiliary scale 24 while segments 26 of pointer scale 20 are separate from this and can be illuminated individually in segments. While pointer 12 displays an instantaneous vehicle speed, the illumination of segments 26 of pointer scale 20 displays a target speed of the vehicle (a cruise control speed). In a first embodiment, scale segments 26 are illuminated to the desired speed, e.g., 80 mph, while all scale segments above this target

speed remain darkened or are only illuminated very weakly. In further embodiments, a change of color of the illumination, e.g., green up to a target speed and red above this target speed, or also by the illumination or darkening of only one scale segment at the point of the target speed makes it possible to display the target speed with pointer scale 20. Except for apertures, dial face 5 is designed to be impervious to light, the apertures forming pointer scales and scale markings for pointer gauges 7, 8, 9 and for speedometer 11. Neither an arithmetic unit to control the cruise control function nor a control unit for the driver to enter the desired speed is shown in Figure 1. In a further embodiment not shown in Figure 1, a second scale marking 23 is omitted and instead only auxiliary scale 24 is arranged on the side of the pointer scale facing away from first scale marking 21 to provide an orientation concerning the dimensions of the entire pointer scale. Similarly, starting with the embodiment described with reference to Figure 1, it is possible to omit the arrangement of auxiliary scale 24.

Figure 2 shows a top view from the position of the dial face to an illumination device according to the present invention in an area of speedometer 11 which is located behind the dial face. In an area beneath pointer scale 20, homogeneous light funnels 31, 31′, and 31″ have been placed in a support 30, a homogeneous light source 32, 32′, 32″ being arranged at the bottom of each light funnel. The size of light funnels 31, 31′, 31″ corresponds roughly to segments 26, 26′, 26″ with the result that one segment 26 of pointer scale 20 according to Figure 1 is illuminated via each light funnel 31, 31′, 31″ with the associated light source 32, 32′, 32″. Support 30 follows a circular form of speedometer 11. A first light source 33 is arranged outside the circle described by support 30. First light source 33, which is preferably in the form of a cold cathode fluorescent tube, runs below scale marking 21 according to the embodiment of Figure 1. An optical waveguide 34 adjoins the inside of the circle described by support 30, across which retaining structures 35, 35′ extend, the retaining structures being molded onto support 30 and representing an extension of support 30. Optical waveguide 34 has output surfaces 36 that are used to output the light that is injected from first light source 33 into optical waveguide 34 and output in the direction of second scale marking 23 or auxiliary scale 24. In a preferred embodiment, output surfaces 36 run roughly parallel to the surface of dial face 5. In a further embodiment, output surfaces 36 are provided with a diffusion imprint or microprisms to ensure an efficient output at output surfaces 36. Optical waveguide 34 is made of a transparent plastic material, preferably polycarbonate. In addition,

the optical waveguide may be made of a light scattering material. Support 31 is preferably made of a reflective plastic material, preferably polycarbonate stained with titanium dioxide to deflect the light emitted from second light source 32 into light funnel 31 and also to deflect the light output from optical waveguide 34 in the direction of dial face 5. In an area 34′ on the side of support 30 facing first light source 33, optical waveguide 34 protrudes over the side of support 30, an output surface 36 being opposite area 34′ on the side of support 30 opposite area 34′.

Figure 3 shows a longitudinal section through the illumination device shown in Figure 2 along line III in Figure 2. Second light source 32 is arranged on a circuit board 37, via which first light source 33 is supplied with an operating voltage. Conductor paths arranged for this purpose on circuit board 37 are not shown in Figure 3. Light source 32 beams light into light funnel 31, which is delimited by reflective walls 38 of support 30. In a preferred embodiment, a lens 39 is arranged on the side of light funnel 31 facing away from light source 32, the lens bundling the light emitted from second light source 32 in the direction of a segment 26 of pointer scale 20 in dial face 5, dial face 5 being supported on lens 39, on a first diffusing screen 45 and on a second diffusing screen 46. First diffusing screen 45 homogenizes the light emitted from first light source 33 immediately in the direction of dial face 5. Second diffusing screen 46 homogenizes the light emitted from optical waveguide 34 or output surfaces 36 in the direction of dial face 5. In a preferred embodiment, both first diffusing screen 45 and second diffusing screen 46 are supported on support 30. In Figure 3, a dashed line represents a retaining structure 35′ which holds optical waveguide 34 against circuit board 37. In dial face 5, light-impervious areas 42 are recognizable adjacent to segment 26, the light-impervious areas being interrupted by apertures for first scale marking 21 and for second scale marking 23 as well as for auxiliary scale 24. The light emitted from first light source 33 is homogenized by first diffusing screen 45 and backlights first scale marking 21 in dial face 5. In addition, light radiates from first light source 33 into optical waveguide 34 through area 34′ of the optical waveguide and is deflected by output surfaces 36 in the direction of second diffusing screen 46 or second scale marking 23 and auxiliary scale 24. In a preferred embodiment, optical waveguide 34 has a reflective surface 41 which is arranged on a side of optical waveguide 34 facing away from output surfaces 36 and totally reflects the light beamed into optical waveguide 34 to second scale marking 23.

Figure 4 shows a longitudinal section through the display device according to the present invention according to line IV of Figure 2. In Figure 4, a segment 26 is assigned to a second light source 32, a segment 26′ is assigned to a second light source 32′ and a segment 26″ is assigned to a second light source 32″. The illumination of individual segments 26, 26′, 26″ is homogeneous. Light funnel 31 proceeds in the shape of a funnel starting from circuit board 37 or second light source 32 and opens in the direction of dial face 5. An aperture 50 for optical waveguide 34 is placed in support 30 between a light funnel 31 to second light source 32 and a light funnel 31′ to second light source 32′, the light from first light source 33, which is not shown in Figure 4, being injected through the optical waveguide in the direction of second scale marking 23 or auxiliary scale 24. Optical waveguide 34 is optically separated from second light source 32 by the walls of light funnel 31, which are not transparent. A dashed line 51 shows the progress of optical waveguide 34 on the side facing away from support 30 according to the view in Figure 4. As soon as optical waveguide 34 has crossed support 30, optical waveguide 34 widens on a side facing dial face 5 and forms output surfaces 36. In the embodiment shown here, light-emitting diodes are used for second light sources 32. However, it is also possible to use other light sources such as incandescent lamps or glow lamps. Since individual segments 26, 26′, 26″ of pointer scale 20 are separated by light-impervious areas 42 of dial face 5, separate illumination of each scale segment is possible through the associated second light source 32, 32′, 32″.